

ESA 162-3_ACH Foods_Champaign, IL

Steam ESA – Public Report - Final

Company	ACH Foods	ESA Dates	September 24 th to 26 th
Plant	Champaign, IL	ESA Type	Steam
Product	Oil based food products	ESA Specialist	Tom Tucker, P.E.

Brief Narrative Summary Report for the Energy Savings Assessment:

Introduction:

On behalf of the Department of Energy, Tom Tucker of Kinergetics LLC conducted a steam system ESA at ACH Foods in Champaign, Illinois from September 24th to September 26th, 2008. The ESA and training activities were provided through the United States Department of Energy-Save Energy Now initiative, which was begun to help the largest natural gas users in the United States identify ways to reduce energy use.

The annual cost for boiler fuel was estimated to be in excess of \$5 million based on the average 2007 gas cost.

Steam System

There are three (3) gas fired boilers on site but only two are normally used to generate steam at 200-psig generating which is then reduced to 125-psig, 50-psig and 5-psig steam based on need. Four (4) additional process boilers are used to provide high temperature process steam but these were not addressed due to confidentiality reasons. The 200-psig boilers are fitted with economizers for exhaust heat recovery.

All condensate is sent to drain due to concerns over contamination from oils. As a result makeup water requirements are high. However, makeup water is preheated from a number of sources that include boiler blowdown, air compressor cooling water, and the desuperheating of ammonia refrigerant hot gas. Careful review of this arrangement indicates significant opportunity for improvement that was already being considered by plant engineering. However, assistance was requested for development of the energy balances.

The average efficiency of the boilers was estimated at 80-percent based on exhaust temperatures and experience. This average “operating” efficiency includes skin losses and part load effects but does not include blowdown losses because they are automatically accounted for by SSAT. The blowdown rate was estimated at 5-percent based on a brief review of conductivity data. The annual operating hours are assumed to be 8,000 for savings estimation purposes.

Objective of ESA:

The primary objective of the ESA was training on steam best practices and opportunities to improve makeup water heating using waste heat. Due to confidentiality reasons, efforts were limited to the boiler house only, although discussions indicated that there are likely significant opportunities in the process areas as well. One example is preheating of the creamer spray dryer inlet air. Metrics were developed to assist in this regard.

Focus of Assessment:

Due to the significant heat reclaim opportunities possible, verification of piping and development of the energy balance for the boiler makeup water heating system were the subject of focus.

Approach for ESA:

The ESA started with an introduction to the different steam tools and a number of common best practice measures.

General Observations of Potential Opportunities:

Below are brief descriptions of each opportunity evaluated. Each opportunity has been rated based on the following definitions:

1. Near term opportunities: Include actions that could be taken as improvements in operating practices, maintenance of equipment or relatively low cost actions or equipment purchases.
2. Medium term opportunities: Require purchase of additional equipment and/or changes in the system such as addition of recuperative air pre-heaters and use of energy to substitute current practices of steam use etc. It would be necessary to carryout further engineering and return on investment analysis.
3. Long term opportunities: Require testing of new technology and confirmation of performance of these technologies under the plant operating conditions with economic justification to meet the corporate investment criteria.

1. Steam Demand Reduction – Reduce Vent Steam/Improve Condensate Recovery (medium term)

Boiler makeup water is heated using heat from liquid cooled air compressors, boiler blowdown and the desuperheating of ammonia refrigerant hot gas. Heat recovery increases the makeup water temperature from approximately 55°F on average to approximately 110°F. While this is a significant temperature gain, there is opportunity to gain additional temperature if heat is recovered from the condensate to the makeup water before the condensate is discharged.

All condensate is presently discharged due to concerns over contaminating boiler feedwater. While it is always desirable to collect condensate directly, staff felt that direct use of condensate poses a significant risk to steam production and were interested in alternative means to achieve a similar result. Heat recovery from condensate to further increase the temperature of the makeup water was already being considered, but personnel requested assistance with the energy balance and related energy cost savings estimates.

The condensate “collected” prior to discharge is approximately 180°F. It is feasible to preheat makeup water from 110°F to approximately 155°F. This is equivalent to an annual energy cost savings of \$246,000.

A gasketed plate and frame exchanger is recommended for consideration because it is easy to clean in the event that oil contamination of the condensate does occur. The estimated purchase cost of a non-sanitary heat exchanger is 15,000 to \$20,000. Considering piping and other installation issues, the estimated installed cost could be less than \$100,000 depending on piping requirements but this needs further consideration.

This opportunity is recommended for further investigation.

Note: This project was not modeled as a steam demand reduction as with SSAT because it was felt that this would overestimate cost savings due to inclusion of system wide energy losses that that may not apply. Rather, the cost savings was estimated considering only boiler efficiency and the energy savings.

2. Improve Boiler Efficiency – Preheat Makeup Water Using an Additional Economizer on Boiler #5

Once the condensate is preheated to a range of 155°F as per opportunity 1 above, it is at sufficiently high temperature to allow additional heating with a boiler economizer. This can be accomplished with an additional economizer or potentially with a heat exchanger to simply extract heat from the feed water entering the existing economizer. This will cool the water into the economizer and allow removal of more exhaust heat with the economizer than already exists. This measure assumes that an additional economizer is added due to the somewhat simpler evaluation.

The exhaust temperature from the Boiler #5 was determined to be approximately 420°F based on temperatures provided in the boiler control room. Preliminary analysis indicates that use of makeup water at 155°F will reduce the stack temperature to approximately 285°F, above the recommended minimum of 250°F. This also provides a margin of safety to help account for different fire rates which will also influence the exhaust temperature. The makeup water temperature is increased to approximately 190°F. This will improve overall boiler efficiency by an estimated 3-percent, equivalent to an annual cost savings of \$215,000. Depending on piping requirements, this cost for this project is expected to range from \$125,000 to \$200,000.

This project is recommended for consideration and implementation as appropriate.

Notes:

1. The economizer should be selected so as to provide the performance described by the temperatures above.

3. Natural Gas Use Reduction – Preheat Inlet Air on Spray Dryer

While the spray dryer for the creamer line could not be specifically reviewed due to restricted access, spray dryers are often suitable for inlet air preheating to reduce dryer gas use. To provide an order of magnitude estimate, it was assumed that the average temperature of the inlet air is 55°F and the energy cost savings estimated from use of waste heat to preheat 10,000-scfm of inlet air. Potential sources of waste heat are the exhaust from the high pressure boiler in the process area and the condensate after it is used to preheat the #5 boiler makeup water.

Considering use of hot condensate after preheating of boiler makeup water, the discharge temperature is approximately 121°F at a flow of 42,560-gph (85-gpm). The condensate can be passed through a plate and frame heat exchanger to heat a glycol loop, which then will heat the inlet air. Under this scenario, the inlet air preheating will reduce the cost of spray dryer operation by approximately \$31,000 per year per 10,000-scfm. Based on similar projects the estimated cost is expected to range from \$175,000 to \$275,000 depending on installation requirements.

This opportunity is recommended for further investigation.

Notes:

1. Spray dryer fan capacity will need to be checked to it will take the increased pressure drop from the inlet air heater.

4. Improve Insulation – Insulate Bare Valves, Hot Water and Steam Lines (near term)

A detailed insulation assessment was not performed although there appears to be significant opportunity for improvement. Examples are hot storage tanks that are approximately 20-feet high and 10-feet in diameter. The temperature on two tanks was measured at approximately 135°F. Assuming the tanks are 75-percent full on average, 3E-Plus was used to estimate the heat loss at \$2,625 per tank for a total of \$5,200.

Other areas for improvement include use of removable wrap insulation on all steam valves and hot water valves. **Table 1** was developed from a Department of Energy “Fact Sheet.” The table can be used to estimate the energy savings from insulating valves with removable insulation 2-inches thick. Removable insulation is appropriate for equipment that normally requires maintenance because it can be easily removed and replaced when work is complete. While more expensive than standard insulation on a per foot basis, it is cost effective and provides simple returns on the order of 1-year for steam valves.

Table 1

Pressure	Temperature	Heat loss (Btu/hr) based on valve size						
		2	3	4	6	8	10	12
55	300	2,420	3,630	4,340	6,500	8,670	10,300	13,010
230	400	4,173	6,260	7,470	11,210	14,940	17,750	22,420
200	388	3,963	5,944	7,094	10,645	14,188	16,856	21,291

Table 1 can be used as follows: The energy savings from wrapping a 4-inch valves carrying 200-psig steam is 7,094-Btu/hr. Assuming the steam plant operates 8,000-hours per year, the annual cost savings will pay for the investment in less than a year based on a cost for the blanket of \$500.

A few suppliers are provided below for convenience but no endorsement of any particular supplier is implied.

- B&B insulation: 920.733.6086
- Advance Thermal Corporation: 630.595.5150
- Coverflex Manufacturing: 713.378.0966

Based on these few examples and observations during the assessment, the annual cost savings potential for the facility could easily be over \$20,000. As a result, an insulation survey is recommended, beginning with steam lines, shell and tube heaters and steam valves and condensate and heated raw material/product tanks.

5. Consider Compressed Air Energy Cost Opportunities

The air compressors are located near the boilers and based on observation of cycle patterns indicate opportunity for improved control. In addition, some “fringe” process areas were briefly observed in moving to and from the boiler house. Based on these observations it is obvious that there are some very good opportunities related to compressed air which can be summarized as follows:

- Controls: The smaller Atlas-Copco air compressor has a predictable cycle pattern with significant blowdown loss, suggesting opportunity for better centralized control using sequencing.
- Waste: Venturi Air Jet Ejector– Upper level of boiler house near door. Normally used for room cooling, but was on for no reason this week. Even if this does work for cooling, it is not a good use of compressed air. Consider fans as an option. If information on the air ejector is available estimates can be made on how much the unit cost to operate. Assuming that the compressors operate at an efficiency of 3.2-scfm/hp the cost of air is approximately \$1.60/hr/100-scfm.
- Leaks: There appear to be a large number. DOE reports that facilities that have not performed leak detection and repair can have 20 to 30-percent of air demand supplying leaks. Based on 900-hp of compressor 80% loaded on average the cost of operation is ~\$300,000/yr. Thus, repair of leaks alone could be worth on the order of \$30,000 to \$60,000/yr. Repair of leaks often has a simple return of less than one year.

There appears to be a significant opportunity related to compressed air and as a result, compressed air optimization is recommended for further consideration.

Management Support and Comments:

Generally, the initial feedback on the ESA was favorable. Overall, facility staff were engaged, helpful and interested.

DOE Contact at Plant/Company: (who DOE would contact for follow-up regarding progress in implementing ESA results...)

Plant Contact: Dick Clark

Company Contact: Dick Clark